#652

The Spruce Beetle
Kenai Peninsula, Alaska
1971-72

(An Office Report)

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INTRODUCTION

The spruce beetle, Dendroctonus rufipennis (Kirby), is potentially the most destructive insect pest of white spruce in interior Alaska. In the past, this insect caused the destruction of a high percentage of spruce within a 200,000-acre outbreak in the Copper River Valley (Downing 1959). In the late 1940's and early 1950's, heavy losses occurred in white spruce stands along the south side of Knik Arm near Anchorage. More recently, the spruce beetle has been active on the Kenai Peninsula since the late 1950's.

Exact information is not available as to the causes of an outbreak or the conditions necessary to maintain high populations. Blowdown, logging operations, land clearing, and road, seismic line and powerline construction may all contribute to the start of an outbreak. The large infestation in Colorado from 1949-1951 was traced to an extensive blowdown that occurred in 1938 (Massey and Wygant 1954). Once populations have built up, large overmature trees with weakened root systems tend to continue the outbreak. The factors that eventually terminate an outbreak are also not thoroughly understood; local weather appears to be a primary agent.

HISTORY

Prior to the 1950's, outbreaks on the Kenai Peninsula are not well documented; however, the spruce beetle probably has been active over a long period of time. Periodic population fluctuations were undoubtedly common and closely associated with settlement activities and weather patterns.

Downing (1959) reported epidemic status in four separate locations on the Chugach National Forest in the late 1950's. The northeastern section of the National Moose Range was also infested at this time. The long-time practice of homesteading, seismic line construction, and road building, together with natural windthrow, supplied ample material for population increase. Unfavorable climate then allowed populations to expand into the larger standing trees. This infestation appeared to die down in 1963 and remained at a low ebb through 1966.

The present active outbreak covered approximately 260,000 acres of white spruce on the Kenai National Moose Range and adjacent State and private lands on the northwest portion of the Kenai Peninsula. These represent population flare-ups within the areas of earlier infestations. More localized infestations occurred on the Granite Creek and Canyon Creek drainages near Hope, Alaska.

The specific reasons for the population fluctuations on the Kenai Peninsula are not known; however, most outbreaks have occurred during periods of warm weather and subnormal rainfall in areas containing abundant breeding material. A supply of suitable downed spruce and the occurrence of temperatures favorable for brood production govern the insects' ability to develop into epidemic populations. The present outbreak has followed in the wake of several years of drought, resulting in stress on mature and overmature stands. The rainfall within the infestation zone has been below the long-term average for 6 of the 10 years from 1961-70 (Table 1)*; The greatest precipitation deficit occurred during 1968-70. The water level

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*All tables and figures are in the Appendix.

of many lakes has dropped drastically, sometimes as much as 6 feet below normal.

The general result of the infestation in most areas on the Kenai Peninsula is a reduction in the size of the residual stand. In the northern area of the National Moose Range, most white spruce over 10 inches d.b.h. have been eliminated from the stands. Type conversion has not occurred, as there are plenty of smaller size spruce to continue the stand characteristics.

The course of this present infestation depends upon local weather and the availability of suitable host material. The infestation may continue until all the larger white spruce are killed.

METHODS

Knowledge on the expected course of an outbreak is needed to aid proper land management decisions. Changes in stand characteristics following an outbreak may dictate land use. The removal of the overmature trees may be a benefit to the overall health of the stand. It may also open up a stand to the extent that more desirable species for wildlife forage gain a foothold.

The observation areas were established in 1971 to follow the progress of the infestations on the Kenai Peninsula. The changes that occur will hopefully be correlated with stand parameters and local weather. The observations will be a cooperative effort between the Institute of Northern Forestry, Fairbanks, Alaska and the Forest Pest Control, R-10, Juneau, Alaska.

The Fish and Wildlife Service on the Kenai National Moose Range were extremely helpful in the project. They devoted time and assistance in locating and getting into the more remote areas by aircraft.

Twenty plots were established in known areas of spruce beetle activity in 1971 (Fig. 1). The plots were located in areas of high mortality south of Pt. Possession to areas of low mortality near Ninilchik. Each plot was referenced by mileage from a known point on the road system; or, in the case of roadless areas, from a landmark on a lake.

Each plot consisted of a 1 x 2 chain (1/5 acre) area oriented with the long axis in a north-south direction (Fig. 2). Corner stakes and a center stake painted orange permanently delineated the area.

All spruce trees over 5 inches d.b.h. were tagged with permanent numbered metal tags. The diameter d.b.h., crown class, crown color, bark characteristics, and infestation class were recorded for each tree. A general description of the ground vegetation was made at the time of plot establishment. A soil pit was dug in the northeast corner of the plot to determine soil type. Increment cores and soil moisture samples were taken later in the summer.

The intention is to examine the plots yearly to determine changes in spruce beetle damage and stand characteristics. If possible, these changes will be correlated with weather patterns.

RESULTS AND DISCUSSION

The following comments represent the conditions that existed at the end of the 1971 field season. Table 2 shows the percentage of trees by crown class in each plot. In general, the majority of white spruce are in the dominant crown class. The percentage of infested trees varied from 0 in the southern area near Ninilchik to 56.3 at Phalarope Lake south of

Pt. Possession (Table 3). Most of the dead trees had also been infested but were not included in the percentage of infested trees. The percentage of infested trees by crown class is shown in Table 4. It is apparent that the greater number of trees attacked by the spruce beetles occurred in the dominant position.

Based on the plots, the basal area of spruce ranged from 57 square feet to 186 square feet per acre. The spruce beetle was primarily responsible for a reduction of 3-75 square feet per acre at plot 14 and plot 13, respectively (Table 5). The percentage of the stand reduced ranged from 3.2 square feet to 67.8 square feet at plot 19 and plot 7, respectively. Most of the trees that were infested were in the larger size class and older age bracket.

Most of the area of heavy infestation occurred in the northern part of the Kenai Peninsula. Road building, powerline construction, homestead clearing, and oil exploration and development may have contributed to large amounts of suitable breeding material. However, climatic factors probably were responsible for continuing the infestation. A period of dry years occurred prior to 1971, resulting in a gradual lowering of the water table throughout much of the area. This lowering was quite noticeable from the air, as most of the lakes and potholes had extensive exposed mud-flat borders. The change in available moisture to the root zone may predispose the trees to bark beetle attack. A research area near plot 18 showed a fairly high attack incidence during the extremely dry year of 1969 and practically no attack during the 1971 season. According to the Fish and Wildlife people, the water table is beginning to climb following near normal precipitation in 1971.

Soil samples taken later in the summer showed a range of moisture content from 38.9 percent to 118.9 percent, based on oven-dry weight. The areas of heaviest bark beetle attack followed the lower part of this scale.

Each plot was revisited in the fall of 1972 and examined to determine any changes that may have occurred as the result of spruce beetle activity. Table 6 shows the changes in basal area per acre, based on this examination. Only four plots showed evidence of new attacks. In addition, three plots showed a change from infested to a non-infested condition. This change resulted from failure of brood development and/or little tree damage as the result of a light or strip attack.

REFERENCES

Downing, G. L. 1959. Biological evaluation of an Alaska spruce beetle infestation in spruce stands on the Kenai Ranger District. Alaska Forest Research Center, Forest Insect Survey Report No. 4. 5 pp.

Massey, C. L., and N. D. Wygant. 1954. Biology and control of the engelmann spruce beetle in Colorado. U.S.D.A. Circular No. 944. 35 pp.

APPENDIX

Table 1.--Number of months of drought during May-August and fluctuation in precipitation from normal during period (1950-1970).

	ANCHORAGE		KASILOF		KENAI		SOLDATNA			
Months of Drought During May-Aug and Excess or Deficite in Precipitation During Period										
1950	3	-3.0			2	-1.5				Drought
1951	2	+0.8			3	-1.5	1	-0.1		
1952	2	+0.2	3	+0.5	3	0.0	3	-0.8	3	-2.5
*1953	2	+1.5	2	-1.3	1	+0.2	2	-1.0	2	-1.7	Dry
*1954	2	-0.8	2	+0.6	2	+1.0	3	-0.8	2	-1.7	Dry
1955	2	+0.2	2	+0.6	2	+2.2	2	+1.0	3	-3.6	
*1956	3	-0.6	0	+0.1	2	-0.6	1	+0.2	2	-2.3	Dry
1957	3	-2.0	3	-2.3	3	-1.5	3	-1.6	2	-3.8	Drought
1958	1	+3.2	0	+2.2	0	+4.7	1	+1.8	0	+1.7	
1959	2	+2.1	1	+0.8	2	+0.3	2	+1.2	3	-2.9	
1960	2	+0.2	1	+2.7	2	+1.0	2	+1.7	1	+0.4	
*1961	2	-0.4	3	-1.0	3	-1.0			2	+0.7	Dry
*1962	2	+1.5	2	-1.3	2	-0.3	2	-0.9	2	-2.0	Dry
1963	1	+1.7	2	-0.5	2	+0.5	2	0.0	2	-2.4	
*1964	2	-0.1	1	-0.4	1	+1.0	2	-1.2	2	-1.6	Dry
1965	4	-1.3			1	+1.0	1	+2.1	1	-0.3	
1966	3	-1.7	1	+0.7	1	+1.5	2	+1.0	1	+2.3	
1967	0	+1.9	2	+2.3	0	+0.9	2	+0.9	2	+0.3	
1968	3	-1.7	3	-3.7	4	-4.0			3	-6.1	Drought
1969	2	-2.5	3	-2.5	4	-3.6	2	-2.2	4	-6.6	Drought
*1970	3	-0.6	1	+0.4	3	-2.6			3	-2.1	Dry

Approximately 1/3 of the total precipitation for any given year occurs during this period (May-August).

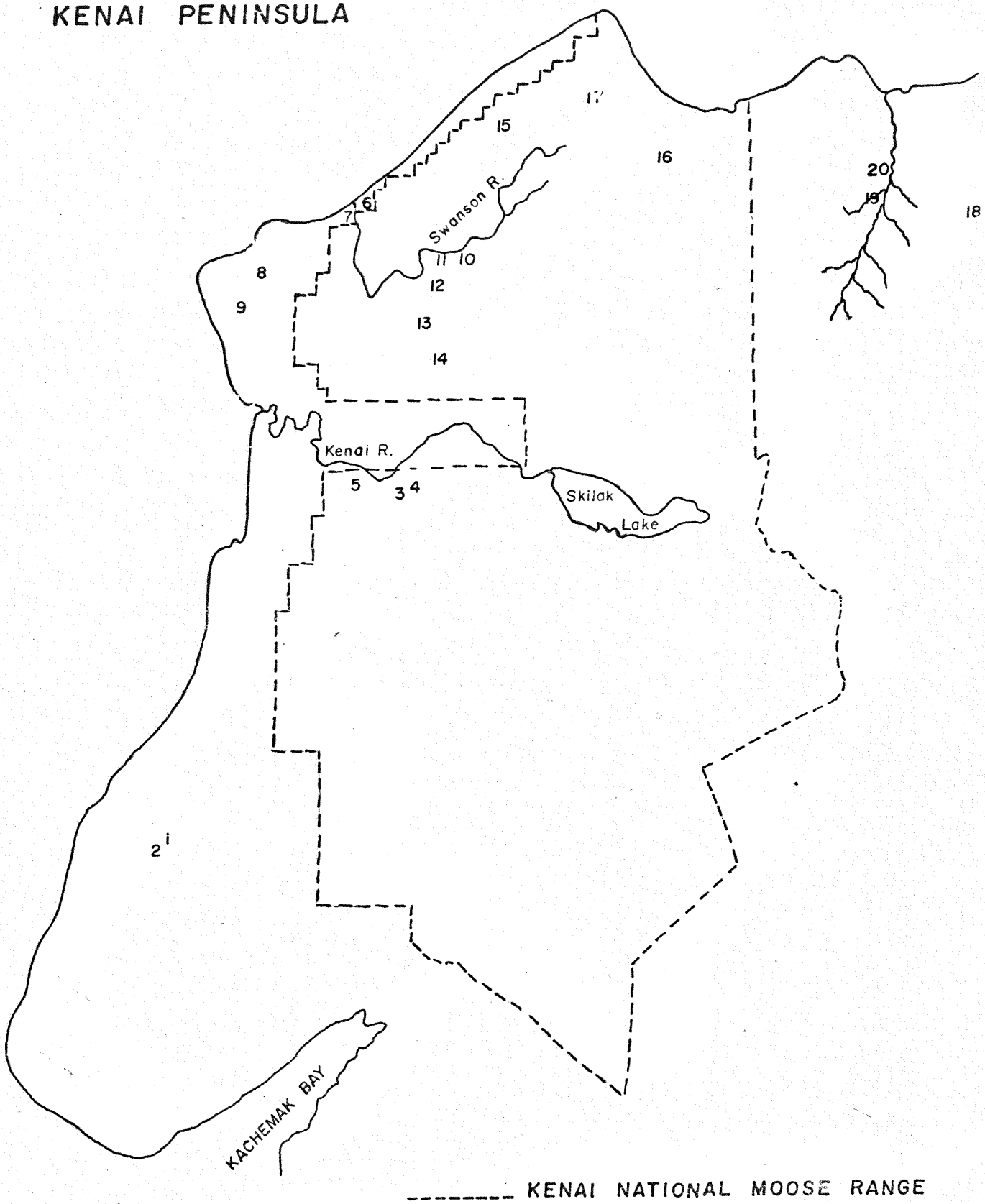

Figure 1.--Plot location on the Kenai Peninsula.

Plot Location

Plot #1: Kingsley Road near Ninilchik; 7 miles from Sterling Highway on west side of road.

Plot #2: Across seismic line about 5 chains downslope from Plot #1.

Plot #3: Funny River Road near Soldotna; 7/4 miles from Sterling Highway on north side of road.

Plot #4: Two chains west of Plot #3, down slope.

Plot #5: Funny River Road near Soldotna; 4.7 miles from Sterling Highway on north side of road.

Plot #6: Shore Road; .2 miles beyond Swanson River Bridge. Five chains in a S 40 E direction from road.

Plot #7: Shore Road; ¼ mile south of Swanson River Bridge on west side of road

Plot #8: Lamplighter Road; 2 3 miles from Shore road, 1.5 chains south of new construction.

Plot #9: Lamplighter Road; 5.3 miles from Shore Road, 2 chains on west side of road.

Plot #10: Swan Lake Road; 1.5 miles from corner of Swanson Lake Road, south side.

Plot #11: Swan Lake Road; .9 mile from corner of Swanson Lake Road, south side.

Plot #12: Swanson River Road; .1 mile north of Dolly Varden Campground, east side.

Plot #13: Swanson River Road; 6.8 miles from Sterling Highway, west side

Plot #14: Swanson River Road; 4.5 miles from Sterling Highway, west side

Plot #15: Hook Lake, north side.

Plot #16: Barabara Lake, south edge of peninsula

Plot #17: Phalarope Lake, southeast corner behind island.

Plot #18: Dry Gulch, 2 chains northwest of powerline. Powerline is about 5 -.75 miles from road.

Plot #19: Resurrection Creek Trail, 6.1 miles on east side.

Plot #20: Resurrection Creek Trail, 3.0 miles on west side.

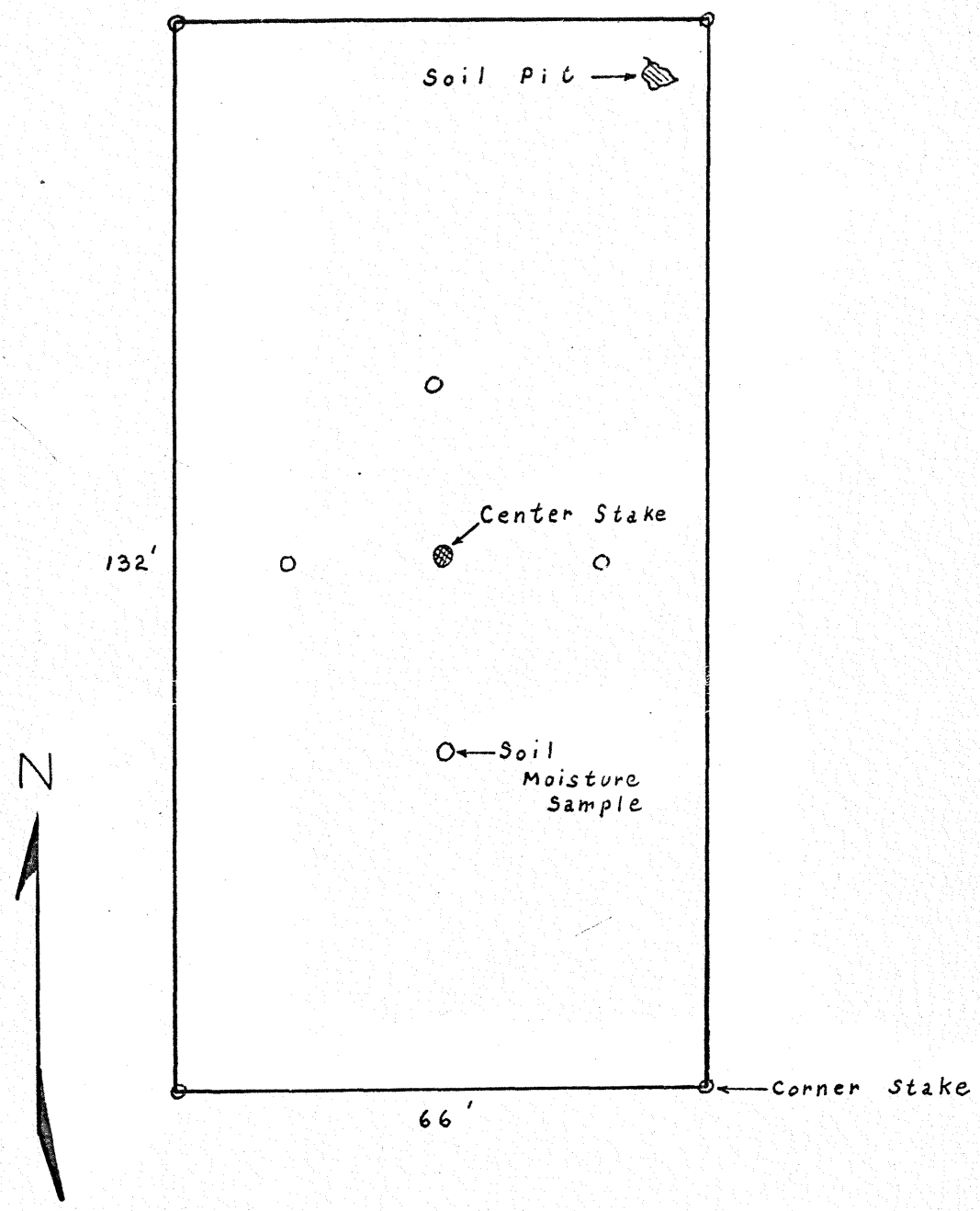

Fig. 2 Schematic diagram of general plot design.

Table 2.--Percent of spruce by crown class.

Plot #	Total Spruce	% in Class		
		Dominant	Intermediate	Suppressed
1				
2	17	88.2	11.8	-
3	30	66.7	23.3	10.0
4	41	56.1	31.7	12.2
5	31	61.3	22.6	16.1
6	19	63.2	15.8	21.0
7	23	52.2	43.5	4.3
8	40	75.0	17.5	7.5
9	38	36.8	55.3	7.9
10	62	61.3	35.5	3.2
11	29	82.8	17.2	-
12	48	39.6	54.2	6.2
13	41	48.8	31.7	19.5
14	35	60.0	40.0	-
15	25	64.0	20.0	16.0
16	39	76.9	17.9	5.2
17	32	46.8	43.7	9.5
18	35	54.3	28.6	17.1
19	40	67.5	30.0	2.5
20	35	60.0	28.6	11.4

Table 3.--Percent of spruce by infestation class.

		Percent		
Plot #	Total # Spruce	Non-Infested	Infested	Dead
1				
2	17	94.1	0.0	5.9
3	30	86.7	10.0	3.3
4	41	68.3	2.4	29.3
5	31	87.1	3.2	9.7
6	19	57.9	31.6	10.5
7	23	43.5	26.1	30.4
8	40	67.5	7.5	25.0
9	38	60.5	5.3	34.2
10	62	88.7	3.2	8.1
11	29	58.6	27.6	13.8
12	48	95.8	2.1	2.1
13	41	51.2	12.2	36.6
14	35	97.1	0.0	2.9
15	25	56.0	20.0	24.0
16	39	69.2	12.8	18.0
17	32	40.6	56.3	3.1
18	35	82.8	8.6	8.6
19	40	95.0	0.0	5.0
20	35	94.3	5.7	0.0

Table 4.--Percent of spruce by crown and infestation classes.

	Non-Infested			Infested			Dead		
Plot #	Dom.	Int.	Supp.	Dom.	Int.	Supp.	Dom.	Int.	Supp.
1									
2	93.3	100.0	-	-	-	-	6.7	-	-
3	85.0	100.0	66.7	10.0	-	33.3	5.0	-	-
4	78.3	53.8	60.0	4.3	-	-	17.4	46.2	40.0
5	84.2	85.7	100.0	5.3	-	-	10.5	14.3	-
6	58.3	100.0	25.0	41.7	-	25.0	-	-	50.0
7	41.7	40.0	100.0	25.0	30.0	-	33.3	30.0	-
8	63.3	100.0	33.3	10.0	-	-	26.7	-	66.7
9	50.0	66.7	66.7	-	9.5	-	50.0	23.8	33.3
10	81.6	100.0	100.0	5.3	-	-	13.1	-	-
11	50.0	100.0	-	33.3	-	-	16.7	-	-
12	94.7	100.0	66.7	5.3	-	-	-	-	33.3
13	40.0	69.2	50.0	20.0	7.7	-	40.0	23.1	50.0
14	95.2	100.0	-	-	-	-	4.8	-	-
15	56.2	60.0	50.0	12.5	20.0	50.0	31.3	20.0	-
16	70.0	71.4	50.0	16.7	-	-	13.3	28.6	50.0
17	13.3	64.3	66.7	80.0	35.7	33.3	6.7	-	-
18	84.2	80.0	83.3	10.5	10.0	-	5.3	10.0	16.7
19	96.3	91.7	100.0	-	-	-	3.7	8.3	-
20	90.5	100.0	100.0	9.5	-	-	-	-	-

Table 5.--Basal area per acre by infestation class, Kenai Peninsula Peninsula, 1971.

Plot #	Total Sq. Ft.	Non-Infested Sq. Ft.	Non-Infested %	Infested Sq. Ft.	Infested %	Dead Sq. Ft.	Dead %	Infested + Dead Sq. Ft.	Infested + Dead %
1	97	67	69.0	6	6.2	24	24.8	30	31.0
2	71	65	91.5	-	-	6	8.5	6	8.5
3	79	70	88.6	5	6.3	4	5.1	9	11.4
4	111	81	72.9	-	-	30	27.1	30	27.1
5	68	56	82.4	5	7.4	7	10.2	12	17.6
6	57	34	59.6	21	36.8	2	3.6	23	40.4
7	59	19	32.2	19	32.2	21	35.6	40	67.8
8	95	62	65.3	10	10.5	23	24.2	33	34.7
9	74	37	50.0	6	8.1	31	41.9	37	50.0
10	120	96	80.0	8	6.7	16	13.3	24	20.0
11	78	30	38.5	22	28.2	26	33.3	48	61.5
12	95	80	84.2	13	13.7	2	2.1	15	15.8
13	126	51	40.5	18	14.3	57	45.2	75	59.5
14	75	72	96.0	-	-	3	4.0	3	4.0
15	128	65	50.8	22	17.2	41	32.0	63	49.2
16	123	83	67.5	22	17.9	18	14.6	40	32.5
17	83	21	25.3	59	71.1	3	3.6	62	74.7
18	186	158	85.0	17	9.1	11	5.9	28	15.0
19	157	152	96.8	-	-	5	3.2	5	3.2
20	109	96	88.1	13	11.9	-	-	13	11.9

Table 6.--Changes in basal area per acre due to spruce beetle activity, Kenai Peninsula, 1971-72.

Plot #	Changes in basal area		
	Non to Inf.	Inf. to Dead	Inf. to Non. *
1	--	- 2.725	--
2	--	--	--
3	--	- 3.955	--
4	--	- 3.080	--
5	--	- 3.925	--
6	--	--	--
7	--	- 2.210	.980
8	--	--	--
9	--	--	--
10	6.135	--	--
11	--	-10.060	--
12	.980	--	--
13	--	- 5.345	--
14	--	--	--
15	--	- 4.470	5.345
16	17.420	- 6.135	--
17	--	-48.540	4.060
18	--	--	--
19	--	--	--
20	4.610	- 3.300	--

* Indicates failure of the brood to develop or the light attack from last year did not harm the tree to any great extent.